

INTERNATIONAL SPACE STATION (ISS)

ESSP RESEARCH OPPORTUNITIES

SECTION 1: INTRODUCTION

The International Space Station (ISS) will provide opportunities for attached payloads at several external locations. These locations consist of the U.S. Truss, the U.S. Truss via the Expedite the Processing of Experiments to Space Station (EXPRESS) Pallet, the Japanese Experiment Module Exposed Facility (JEM-EF), and Columbus External Payload Facility (EPF). Each site offers unique capabilities and environments. Non-standard sites, which may not provide power or data through the ISS, may also be considered on a case-by-case basis. In addition to the attached payload opportunities, additional research opportunities are available in the internal, pressurized Window Observational Research Facility (WORF).

Figure 1 shows the standard attached payload and logistics sites on the ISS. The WORF, which resides in the window in the U.S. Lab, is not visible in this view.

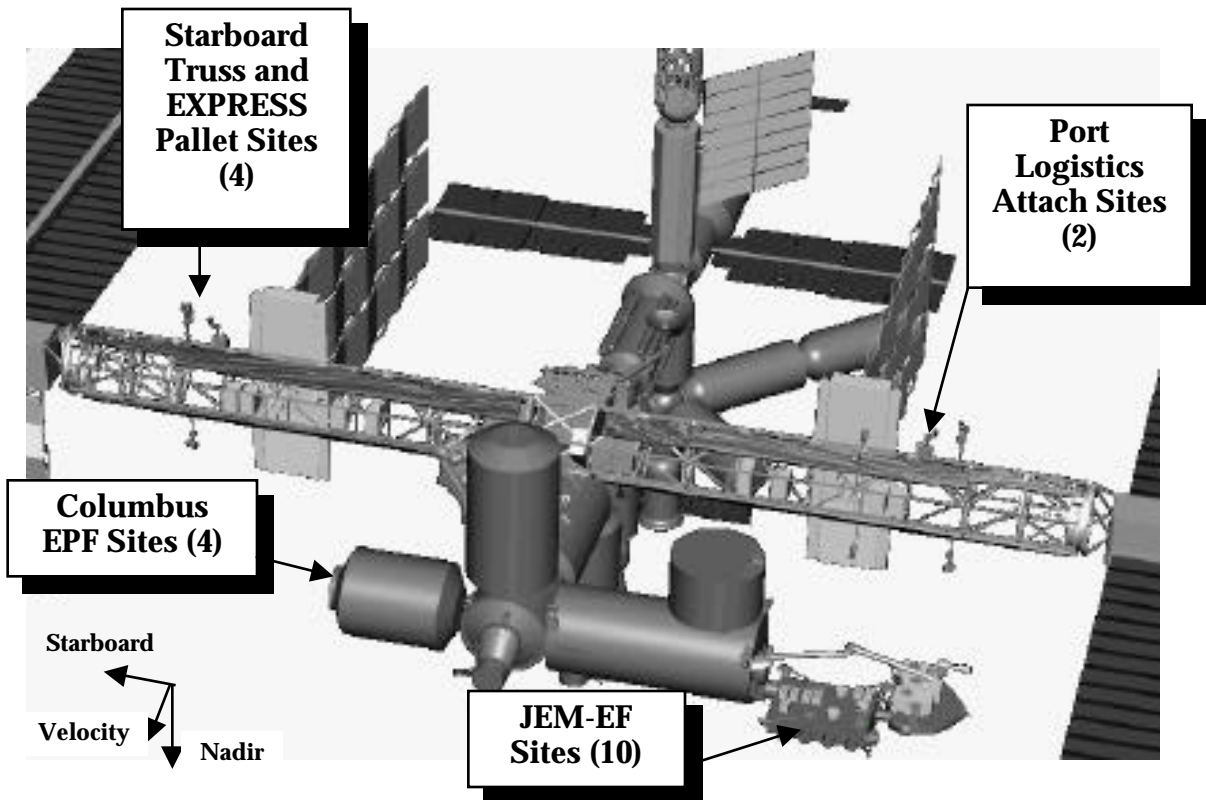


Figure 1. Attached payload sites on the ISS.

SECTION 2: ISS ENVIRONMENT

The ISS is currently in the process of being assembled on-orbit. While assembly complete is anticipated in the 2006-2007 timeframe, attached payloads will be flown during assembly after the attach sites become available. The U.S. Truss sites are anticipated to be manifested no earlier than 2004, followed by the JEM-EF and the Columbus EPF in 2005-2006. At this time, there is no opportunity for attached payloads to return on the Shuttle until after assembly complete.

The WOLF is scheduled for launch in 2002. WOLF payloads may be launched on subsequent flights. Launch and return manifesting and on-orbit duration will be determined for individual payloads based on payload requirements and Shuttle pressurized space availability.

Orbit

The ISS orbit will have an inclination of 51.6 degrees with an altitude that varies between 350 and 470 Km due to the solar cycle. After initial assembly operations, the ISS orientation is continuously pointed nadir to earth. The potential viewing zone covers approximately 85% of the globe and 95% of the Earth's population. The orbit regression rate is one full orbit in two months and the ISS will fly over the same spot on the Earth's surface approximately every 3 days. It will cover the same spot with the same lighting conditions approximately every 3 months. The ISS will pass regularly through the South Atlantic Anomaly.

Attitude

The ISS will use the Global Positioning System (GPS) to determine the ISS state vector (position and velocity), attitude and altitude rates, and a time reference. GPS antennas will be located at the S0 truss segment. The system will provide a total position error of <3000 feet RSS (3 sigma) and an attitude error of <0.5° per axis (3 sigma) at the GPS antenna site. This position knowledge will degrade with distance from the GPS antenna site with a worst case knowledge of 3.0 degrees (3 sigma) and an expected knowledge of ~1 – 2 degrees (3 sigma) at the S3 truss attach sites. The Station will estimate the on-orbit inertial rates at the GPS origin to within 0.01° per second per axis, at a 0.5 Hz bandwidth.

The vehicle stability will be at least 3.5 degrees/axis/orbit (peak-to-peak) and it is expected to be better than 2.0 degrees/axis/orbit (peak-to-peak). Payloads may need an active pointing system and star tracker to accurately point at chosen targets. Pointers will not be provided by the ISS program and are the sole responsibility of the Payload Developer. Pointers, which have the potential of being modified for other payloads, are being developed by European Space Agency (ESA) for specific EXPRESS Pallet adapter payloads.

ISS Induced Environment

The requirements for the overall ISS induced environment specify the values for molecular column density and permanent molecular deposition as seen in Table 1.

Table 1. Overall ISS Induced Environment Requirements

Parameter Modeled	ISS Requirements: Quiescent	ISS Requirements: Non-quiescent
Molecular Column Density	1×10^{14} molecules/cm ²	Unlimited density is allowed, but frequency is limited
Permanent Molecular Deposition	1×10^{-14} g/cm s ² (30 Å/yr)	1×10^{-6} g/cm s ² (100 Å/yr)

There are three primary sources of induced contamination: deposition due to material outgassing, CO₂ dumps, and waste gas vents from pressurized payload racks or other attached payloads. Outgassing deposition at the attached payload sites is due primarily to neighboring attached payloads. Waste gas vents are short in duration and should be scheduled. CO₂ vents cannot be scheduled, but they do not exceed ISS induced environment requirements

The ISS Program and the appropriate Research Program Offices are developing molecular deposition requirements for individual payloads. Payloads that are extremely contamination sensitive should consider making their own deposition measurements in addition to providing protection for contamination sensitive surfaces. The deposition contamination requirements for the full truss sites, which include the integrated pallets, restrict molecular deposition to 1×10^{-15} g/cm² s on sensitive ISS elements and 1×10^{-14} g/cm² s on other payloads. The contamination environment of the EXPRESS Pallet location will necessarily be determined by the Pallet analytical integration once all Pallet payloads have been selected. Contamination requirements for EXPRESS pallet payloads are located in the EXPRESS Pallet Interface Definition Document (SSP 52000). The payload contamination requirements for the JEM-EF and Columbus EPF sites have not yet been determined.

Safety

System safety from both a Space Shuttle and ISS standpoint will require significant consideration. The safety process is described in NSTS 1700.7, Safety Policy and Requirements for Payloads using the Space Transportation System and ISS Addendum and NSTS 13830, Implementation Program for STS System Safety Requirements.

Payloads will be required to complete the safety review process prior to shipping their equipment to Kennedy Space Center (KSC) for integration on the ISS carrier hardware and installation into the shuttle. Upon completion of on-orbit activities on the ISS, all U.S. payloads are required to be returned to earth via the shuttle. Payloads are therefore required to address the retrieval hazards in their flight hardware designs and during the pre-launch safety review process. Prior to the actual retrieval operations, the payload organization must support a delta safety review.

Launch Vehicle

Full truss site, EXPRESS Pallet, JEM-EF, Columbus EPF, and WOLF payloads will be launched on the Space Shuttle. With the exception of full truss payloads, carriers for individual payloads will be provided by the ISS Program. JEM-EF payloads may also be launched on the Japanese HTV vehicle, although they must return on the shuttle.

SECTION 3: EXPRESS PALLET PAYLOADS

The EXPRESS Pallet provides the capability for six payloads to reside on a full truss attach site as seen in Figure 2. Each payload sits on an adapter plate, which attaches and detaches from the EXPRESS Pallet. Each pallet adapter plate is capable of accommodating two payloads for power and data. The EXPRESS Pallet is managed by NASA, and the hardware is being provided by Brazil.

Capability Per Payload

The payload mass limit is 227 Kg and must fit within an envelope of 1.1m (l) x 0.86m (w) x 1.2m (h). Power is provided via two 120 Vdc feeds and two 28 Vdc feeds. The maximum power available for an integrated pallet is 2.5 kW to be distributed between the six pallet adapter payloads. In reality, power usage at each adapter site will probably be limited by the thermal dissipation capability, which is site dependent. No thermal control is provided by the Pallet, and dissipation of heat into the Pallet structure is limited to 50W. Data and command are available via a MIL-STD-1553 bus at up to 100 kbps and Ethernet access to the high rate data link is available at ~6Mbps for the integrated pallet.

The six payloads on a nadir Pallet sit on the nadir face of the Pallet. The Pallet itself sits on the wake side of the U.S. Truss with its longest dimension perpendicular to the Truss. All six payloads have a nadir field-of-view. The two payloads closest to the Truss will also have a ram (ISS velocity direction) field-of-view. The two payloads farthest from the truss have a wake field-of-view.

EXPRESS Pallet payloads will be provided with a Pallet adapter plate, which also contains the necessary interfaces to the Station robotic arm. The first complement of Pallet payloads will be integrated with the EXPRESS Pallets at the Kennedy Space Center and launched on the EXPRESS Pallets. For the earth viewing payloads, the integrated EXPRESS Pallet will be robotically installed on a Starboard nadir attach site. At the end of their mission life, payloads on their Pallet adapter plate will be retrieved individually by the Station robotic arm, placed on a carrier provided by the ISS Program, and returned via the Shuttle.

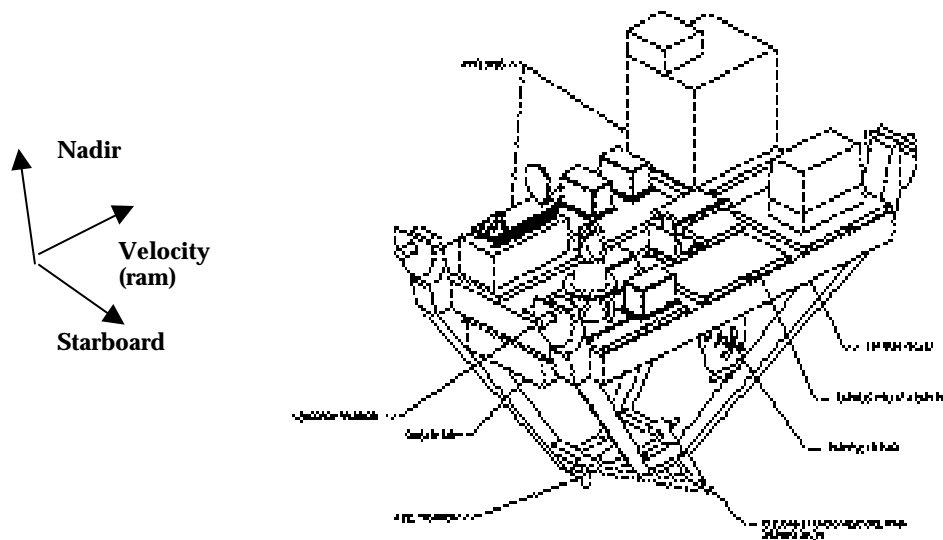


Figure 2. EXPRESS Pallet configuration

SECTION 4: JAPANESE EXPERIMENT MODULE - EXPOSED FACILITY (JEM-EF) PAYLOADS

The JEM-EF is attached to the port end of the Japanese pressurized module. This facility provides twelve attach sites: four on the ram side, four on the wake side, two on the port end, and two on the zenith face. One ram site and one port site are reserved for NASDA facility hardware; the Inter-orbit Communication System (ICS) and the Experiment Logistics Module – Exposed Section (ELM-ES). Of the remaining ten sites, five are allocated to NASA and five to NASDA. The JEM-EF configuration is shown in Figure 3. The sites on the side of the JEM-EF can all view zenith and nadir simultaneously. The two sites on the zenith face can only view zenith, ram, and wake. The JEM-EF payload sites can accommodate two mass classes of payloads. Eight sites are limited to 500 Kg. The ram-port site, EFU #9, and the innermost wake site, EFU #2, can both accommodate 2500 Kg. The payload envelope is 0.8 m x 1.0 m x 1.85 m with the longest dimension radiating from the JEM-EF.

Power, data, and thermal accommodations on the JEM-EF are site dependent. The JEM-EF can provide a maximum of 10 kW to all payloads simultaneously and this is shared at some level with JEM internal payloads. Each site has the capability for 3 kW and the innermost ram and wake sites (EFU #1 and EFU #2) can provide 6 kW. All sites provide a MIL-STD 1553B primary and secondary channel data interface. The eight payload sites on the sides of the JEM-EF connect to an FDDI 100 Mbps high rate data transmission line and a video line. Seven sites connect to the medium rate Ethernet transmission system. The MIL-STD 1553 and Ethernet connections can be configured to use either the US or the NASDA data busses/LANs. Two of these sites are on the zenith face and the other five are on the sides. All payload sites are provided with active thermal control using coolant. Each site has a maximum

heat rejection capability of 3 kW except the innermost side sites, which can reject 6 kW. The maximum simultaneous heat rejection capability of the JEM-EF is 10 kW for payloads, which must be operationally shared with other external payloads and at some level with JEM internal payloads.

Payloads may be launched via the Japanese H-IIA Transfer Vehicle (HTV) or the NASA shuttle. They will be installed robotically on the JEM-EF site. The JEM has its own robotic arm, which can service any JEM-EF payload. Payloads can also be accessed robotically by the astronaut crew via the JEM airlock. Payloads will be returned on the shuttle or may be destroyed in the atmosphere by returning on the HTV.

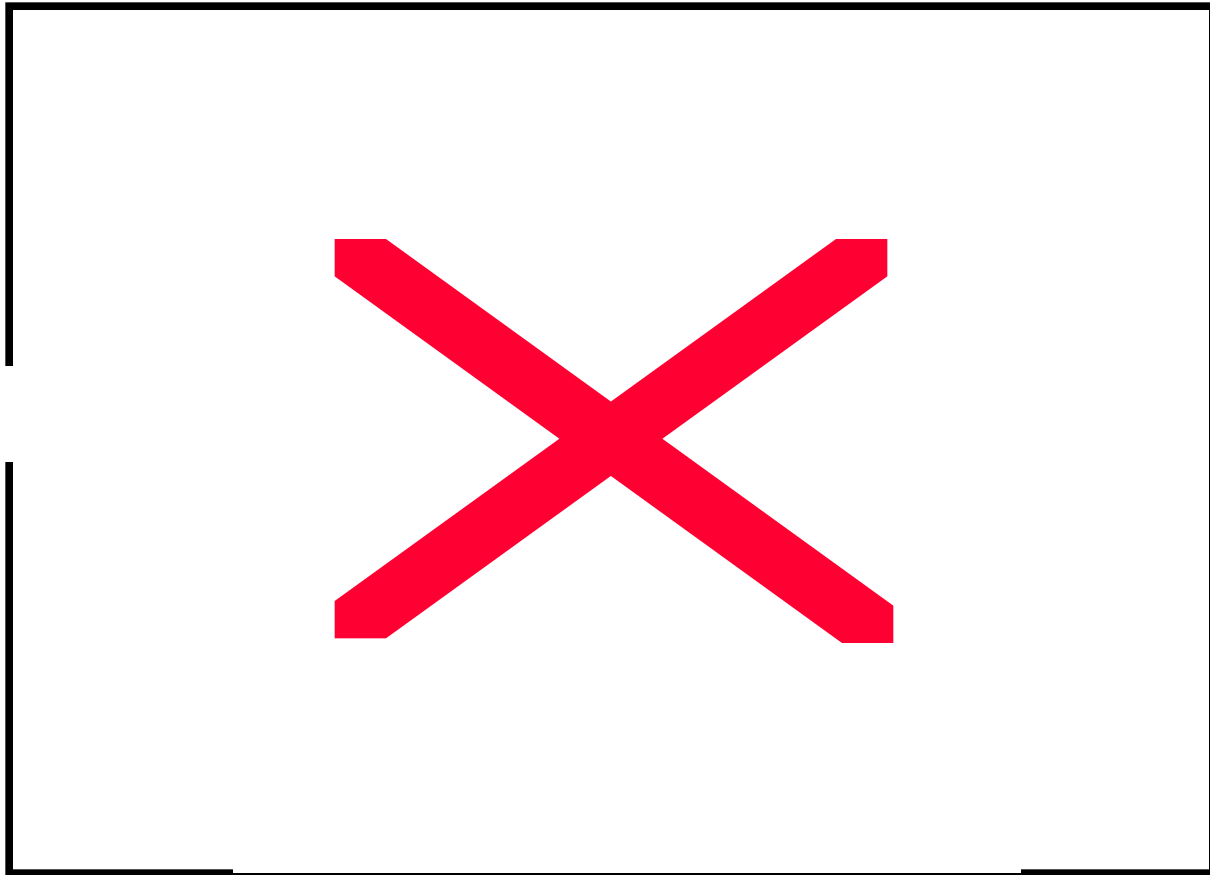


Figure 3. JEM-EF

SECTION 5: COLUMBUS EXTERNAL PAYLOAD FACILITY (EPF)

The Columbus External Payload Facility (EPF) is located at the starboard end of the European Space Agency (ESA) Columbus Module. There are four payload attach sites, two of which are allocated to NASA and two to ESA. Two of the sites have nadir viewing, two have zenith viewing, and all four can view ram and limited wake. The Columbus with EPF are shown in Figure 4. The sites are being designed to accommodate an EXPRESS pallet adapter. The allowed mass and size will therefore be very similar to those for a subpallet payload; 227 Kg mass and a 1.1m (l) x 0.86m (w) x 1.2m (h) envelope.

The payload mechanical interface to the site is the same Flight Releasable Attachment Mechanism (FRAM) that is used to attach EXPRESS pallet adapters to the pallet. Payloads requiring a larger mass allocation may elect to use a different interface mechanism and will be considered on a case-by-case basis. Such payloads would be required to provide their own interface mechanism.

The payload power and data are provided through the Columbus pressurized services. Two redundant 120 V power feeds are provided per payload site. The EPF can provide 2.5 kW to any individual site, but the total power available for all four sites is also 2.5 kW, necessitating power sharing and lower power allocations per payload. Redundant MIL-STD-1553B data interfaces are provided for each site and can be configured to use either the U. S. 1553B payload data bus or the ESA 1553B payload bus. The Columbus also provides a redundant pair of LAN

interfaces, again either U.S. or ESA LAN may be selected. The EPF will not provide active thermal control for any payload site.

EPF payloads will be transported to and from orbit on the NASA shuttle using a program supplied carrier. Placement and retrieval will be accomplished via the shuttle and station robotic arms.

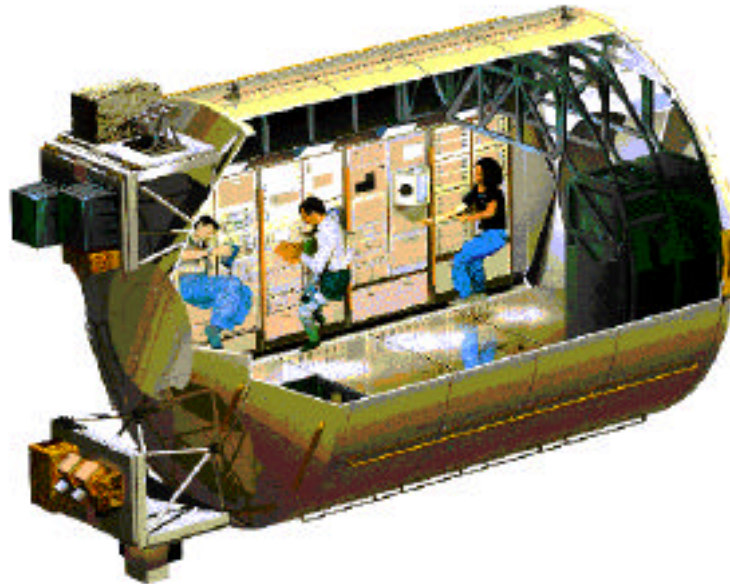


Figure 4. Columbus EPF

SECTION 6: WINDOW OBSERVATIONAL RESEARCH FACILITY

The Window Observational Research Facility (WORF) will be a single-rack facility on ISS built to take advantage of the high optical quality nadir research window. This facility will allow deployment of payloads as large as a 23 cm film aerial photography camera; the optical quality of the window will allow deployment of payloads with optical diameters of up to 30.4 cm. The WORF is being built by the Boeing Corporation at Marshall Space Flight Center.

The nadir window in the U.S. Laboratory is a 50.8 cm clear aperture, fused silica window with a total of four panes. The outer most pane, called the debris pane, is 0.86 cm thick and serves as a sacrifice pane to absorb micrometeorite and orbital debris (MMOD) impacts without damaging the pressure panes. This pane is designed to be removable on-orbit, so that any progressive deterioration in the optical quality of the pane can be eliminated with a new pane. The next two panes are the secondary and primary pressure panes. These panes are 3.175 cm thick. The innermost pane, the scratch pane, is designed to protect the primary pressure pane from damage due to loose tools and other debris in the ISS, and will be removable. The combined set of pressure panes and debris pane will have an average optical performance of $\lambda/14$ wave peak-to-valley over 6" (reference wavelength of 632.8 nm), which will give excellent optical performance. It is estimated that this window will be able to support, without window-induced optical degradation, a payload having a 30.4-cm optical diameter. The window panes are given an anti-reflection coating which provides the best transmittance in the near UV, visible and near IR bands. The window transmittance curve is shown in Figure 5. This curve is in the process of being updated based on recent calibration tests.

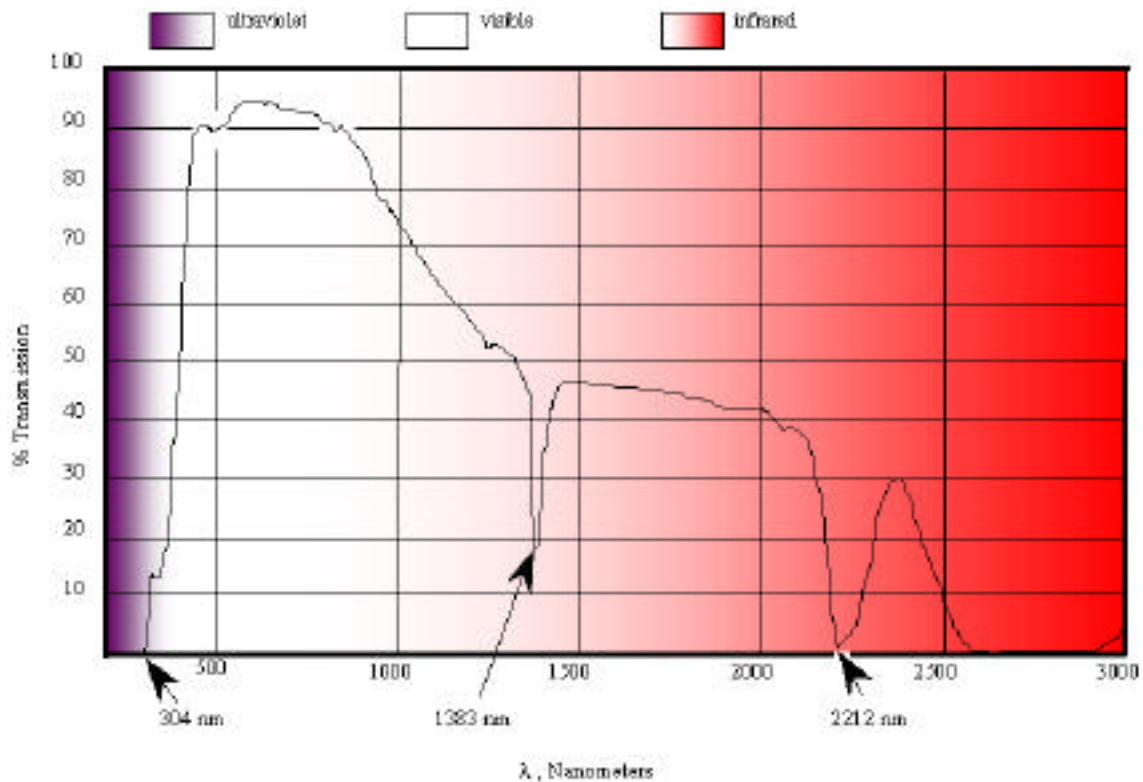


Figure 5. Window Transmittance Curve

The WORF rack is based on a modified EXPRESS rack. This rack is designed to give payloads access to power, data, moderate temperature cooling, video downlink, and a stable mounting area with standardized interfaces for payload deployment. The WORF is designed to handle a payload with maximum dimensions of 53.3 cm wide by 50.8 cm deep by 76.2 cm long and a maximum mass of 136 Kg. The WORF and nadir window are shown in Figure 6. It is anticipated that the WORF will supply interfaces for payload mounts on the sidewalls of the payload volume, and will provide a standard bolt interface on the lower surface of the payload volume for payload and avionics mounting.

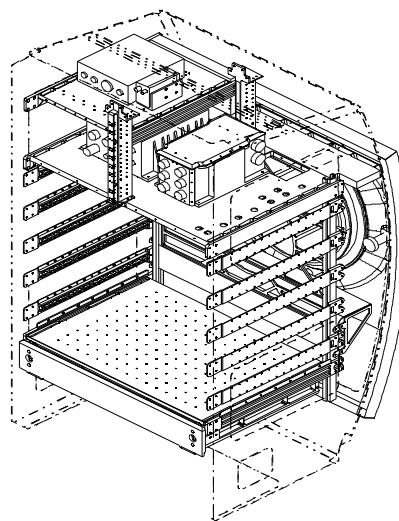


Figure 6. WORF Schematic

There will be interfaces within the payload volume to provide payloads access to ISS power, data, and cooling utilities. The WOLF will provide payloads with a maximum power of 2 Kw supplied at 28 Vdc. The actual payload allowable power draw will be determined by the thermal system capacity. The power distribution will be to 2-14 payload area interfaces, 1 front panel and 1 camera area interface for laptops, and the WOLF avionics systems.

The maximum data rate will be up to 10 Mbps. Instrument data will be collected by Ethernet 10BaseT and Serial RS-422 with selectable baud rates, or RS-170A differential video. Instrument data will be distributed based on the data rate. Low rate and health and safety telemetry, medium rate telemetry, high rate telemetry, and video are available. The interior of the WOLF will be designed to be light-tight and low-reflectance, so payloads will be able to observe low-light-level phenomenon such as aurora, and also will be able to support radiometric measurements. At present, design studies are underway to provide the WOLF with passive rack-level vibration isolation so as to provide a stable environment for payload operations.

WOLF Payloads can be operated in any number of ways, ranging from complete crew control of payload operation to completely autonomous, ground-commanded operation with the only crew interaction being initial set-up. For payload set-up, the scratch pane will be removed and a bump shield integral to the WOLF will be deployed to prevent damage to the aft surface of the primary pressure pane by floating debris. Once payloads are mounted and under control, the bump shield will be retracted and the payload optics will be able to be moved into position directly adjacent to the pressure pane to take advantage of the optical quality of the window. It is anticipated that payload developers will provide all necessary mounting hardware, which will, in turn, mount to the interfaces provided in the payload volume.

SECTION 7: PAYLOAD ON-ORBIT OPERATIONS

The Marshall Space Flight Center's Payload Operations Integration Center (POIC) manages the planning and execution of on-orbit ISS payloads and payload support systems in coordination/unison with distributed International Partner Payload Control Centers, Telescience Support Centers (TSC's) and payload-unique remote facilities. These are supported through various payload operations configurations with the POIC.

One such operations configuration allows users to remain at their home site and obtain a copy of the PC Based Telescience Resource Kit (TReK) software and associated Commercial Off the Shelf (COTS) software. TReK software provides local telemetry, command, and database capabilities and access to the POIC capabilities and interfaces. Capabilities provided by TReK include the capability to receive, process, record, and forward real-time and playback telemetry, uplink and update payload commands, perform local exception monitoring, local calculations, word processing, file management, and control telemetry and command processing using local databases. Information needed to populate a TReK database can be downloaded from a supporting facility (POIC or Telescience Support Center) database. Mission execution and mission planning tools can also be accessed from a TReK system.

Additional information on the MSFC POIC and TReK systems can be found on the following website:
<http://trek.msfc.nasa.gov/>

SECTION 8: PAYLOAD SUPPORTED STS/ISS REVIEWS and DELIVERABLES

The payload developer must support a certain template of ISS Program reviews and deliverables. The following is a minimum, but not limited to, list of those items:

Reviews (Payload Must Attend)

	<u>Approx. Date</u>
Flight/Ground Payload Safety Review – Phase 0/1	L- 2 yr
Flight/Ground Payload Safety Review – Phase 2	L-18 mos
Payload Increment Requirements Review (PIRR)	L-12, L-8, L-4 mos
Flight/Ground Payload Safety Review – Phase 3	L- 9 mos
Certification of Flight Readiness 1 (CoFR 1) Review	L-10 wks
Certification of Flight Readiness 2 (CoFR 2) Review	L- 6 wks
Stage Operations Readiness Review (SORR)	L- 3 wks

Reviews (Payload May Need To Provide Inputs)

	<u>Approx. Date</u>
Increment Requirements Review (IRR)	L-12 mos
Cargo Integration Review (CIR)	L- 9 mos
Increment Operations Readiness Review (IORR)	L- 9 mos
Increment Flight Operations Review (IFOR)	L- 7 mos
Increment Operations Review (IOR)	L- 6 mos
Flight Operations Review (FOR)	L- 4 mos
Flight Readiness Review (FRR)	L- 2 wks

Deliverables

	<u>Approx. Date</u>
Flight/Ground Payload Safety Data Packages-Phase 0/1	L-26 mos
Flight/Ground Payload Safety Data Packages-Phase 2	L-20 mos
Flight/Ground Payload Safety Data Packages-Phase 3	L-11 mos
Payload Integration Agreement (PIA)	Refer to Site Specific Documentation
Mission Evaluation Sheet (MER)	Refer to Site Specific Documentation
Baseline Payload Verification Plan	Refer to Site Specific Documentation
Completed Payload Verification Requirement Sheets	Refer to Site Specific Documentation
Draft System Requirements Data Set (SRDS)	Refer to Site Specific Documentation
Baseline SRDS	Refer to Site Specific Documentation
Ship Payload to KSC	L-6 mos (Nominal)
Payload Turnover to KSC	L-4.5 mos (Nominal)

SECTION 9: PAYLOAD COST ASSUMPTIONS

The proposer should not cost shuttle launch or landing services to the extent described below. The NASA ISS Payload Office and KSC budget process provides annual funding for KSC Launch and Landing Site payload processing. This processing is based on the Launch Manifest and approved support requirements as developed through the KSC Support requirements data set (SRDS) that is published as part the ISS payloads data set, SSP 52000-PDS.

The existing KSC capabilities and services that are funded through the NASA budget process are found in Table 2, Launch and Landing Site Services for NASA Sponsored Payloads. This table will be included in Revision B of the SSP 52000-PDS, now under review. It contains the most current information on provided services. The KSC assigned Launch Site Services Manager (LSSM) will assist the PD when discussing the nominal levels of support. If facilities, equipment, or service capabilities are requested that are greater than nominal levels of services

available, then payload unique requirements, along with the Payload Developer (PD) unique requirement rationale, will be documented in Section 1.3 of the Payload Integration Agreement (PIA) Addendum. These unique capabilities or services will be optional costs to the PD unless approved and funded through the ISS Payloads Office. Payload Developers should cost exceptional capabilities and services in their proposal cost estimate.

Other on-orbit services provided to payloads by the ISS Program include command, telemetry, and data transmission with Level 0 processing performed at the MSFC POIC. Data is then shipped to the user. Limited operations such as high level health and safety monitoring may also be performed at the MSFC POIC. Operating systems such as the MSFC TReK, for command and telemetry from a payload operations center, can be provided at a minimal cost to the payload developer and must be included in the cost estimate. This assumes the operating platform is provided by the payload developer.

EXPRESS Pallet adapter hardware and the payload shipping container will be provided to EXPRESS Pallet payloads and payloads planning to use the Columbus EPF. The integration of the payload to the Pallet is provided without charge, but must have personnel support by the payload developer. Payload mockups for astronaut crew training are not anticipated to be required unless the payload exceeds the standard volume. However, if training aids/mockups are required, the PD must provide these and include them in their proposal cost estimate. Interfaces to the EXPRESS Pallet, JEM-EF, or Columbus EPF are the joint responsibility of the payload developer and the ISS facility project. Interfaces between the Pallet and the ISS and between the Pallet and the Shuttle, including the associated documentation, are the responsibility of the EXPRESS Pallet project and provided at no cost.

Table 2. Launch and Landing Site Services for NASA Sponsored Payloads

SC Support Services		
Operations Support Services		Institutional Support Services

Pre-arrival planning/analysis support Ground Safety Review process Transportation support Arrival-Aircraft/Barge/Truck Facility to facility Intra-facility Facility Utilization Space Station Processing Facility (SSPF) Offline User Rooms Life Science Processing Facility SSPF Crane support KSC Ground Support Equipment Communications including Operational Intercommunication System (OIS) Warehouse storage (limited) Packing/crating shipping support Control work area access badging Training for facility access and certifications Clean room garments Sampling and analysis (select) Tools and special test equipment Lifting equipment proof load Equipment calibration Technical shops Office space Photographic services Hazardous waste disposal Consumables (GN2, He, shop air, ISS flight water) Computer Ethernet connections Chemicals (select) KSC Technical Document Center	1. Emergency medical 2. Copy center and self service document reproduction 3. Self service document facsimile transmission 4. Federal Telephone System 5. KSC reference library* 6. Bus service between buildings* 7. Cafeteria (first shift only)* 8. On-Center commercial travel office* 9. KSC wide security access 10. On-Center security escort for equipment moves 11. Janitorial services* 12. Mail service* 13. KSC area access badging 14. U.S. Customs planning/assistance support 15. KSC Telephone Operator Support*
	* Monday thru Friday, 8:00am – 4:30pm

SECTION 10: APPLICABLE DOCUMENTATION

NASA applicable documents are available through website libraries maintained by the ISS Program at the Johnson Space Center in Houston, Texas. JEM-EF and Columbus EPF documents are maintained by NASDA and ESA, respectively.

General

ISS User's Guide-Release 2.0 (ISSUG), <http://spaceflight.nasa.gov/station/reference/index.html>

EXPRESS Pallet Payloads

SSP 52000-IDD-EPP, EXPRESS Pallet Interface Definition Document, Draft 3

SSP 52000-PAH-EPP, Payload Accommodations Handbook EXPRESS Pallet Payloads, Draft 2

SSP 52000-PVP-EPP, Generic Payload Verification Plan EXPRESS Pallet Payloads, Draft 1

JEM-EF Payloads

JBX-98079, Introductory Guidebook for JEM Exposed Facility Potential Users, October 1998

EPF Payloads

COL-RIBRE-MA-00007-00, Columbus Payload Accommodation Handbook, Rev I

WORF Payloads

SSP 52000-PIH-WRP, WORF Rack Payload Integration Handbook, Baseline, Volumes 1-6

ISS Mission Template

SSP 57057 ISS Payload Integration Template

SECTION 11: OES RESEARCH PROGRAM OFFICE FOR ISS UTILIZATION

The OES Research Program Office (RPO) for ISS utilization is the primary point of contact for earth science proposers interested in flying NASA payloads on the ISS. Questions regarding ISS utilization, accommodations, and interfaces should be addressed to the Research Program Manager, Betsy Park, GSFC Code 800.G, Greenbelt, MD 20771, (301) 286-7062, fax (301) 286-1694, bpark@pop400.gsfc.nasa.gov.

The OES RPO assists Headquarters with strategic and tactical planning, international bartering, and serves as the OES representative on ISS review panels, task committees and working groups. The OES RPO also serves as a payload representative to the ISS Program Office for review of ISS documentation pertaining to payloads and for providing Increment Scientists to represent the OES payloads during on-orbit mission operations. The OES RPO is responsible for working ISS allocations, manifesting, ISS and STS interfaces for payloads and issues regarding the above. Mission management of OES ISS payloads will be handled in the same manner as other ESSP missions, however, the OES RPO will support the selected ISS payload in coordinating payload planning, accommodations, allocations, manifesting, development, integration, operations and payload retrieval. The OES RPO acts to shepherd the payload developers through the STS/ISS systems, documentation, procedures, and reviews from beginning to end. The OES RPO has final Certificate of Flight Readiness signature responsibility to the ISS Payloads Office.